Measurement of the Strength of the ^{10}C Superallowed Branch with GAMMASPHERE

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The u-d element (V_{ud}) of the Cabibbo-Kobayashi-Maskawa (CKM) quark-mixing matrix is a fundamental parameter of the Standard Model of Electroweak Interactions. Its most precise determination comes from nuclear physics experiments, in particular, from measurements of superallowed Fermi beta decays. These measurements, requiring both precision nuclear physics experiments and state of the art theoretical nuclear physics calculations, have been made for a variety of nuclei ranging from ^{10}C to ^{54}Co. The V_{ud} parameter obtained from these measurements implies a non-unitary CKM matrix, which if correct would require exotic extensions to the Standard Model. Unfortunately the theoretical calculations of the isospin breaking corrections, necessary for extracting V_{ud}, are controversial. For example, Wilkinson [1] has suggested that these calculations are incomplete and that isospin-breaking corrections must be extracted empirically.

In order to resolve this controversy, much effort has recently been invested in making improved measurements of the superallowed decay of ^{10}C [2, 3], where the isospin breaking corrections are expected to be small and any residual charge dependent corrections will be apparent. This is a very challenging measurement since the beta decay of ^{10}C has a small superallowed branching ratio which must be precisely determined in a high background environment. We are currently engaged in a series of experiments to measure the superallowed branching ratio of the ^{10}C beta decay using the GAMMASPHERE facility at the LBNL 88-inch Cyclotron. The first data run resulted in a branching ratio of $1.4665(38) \times 10^{-2}$ [3]. A second high statistics run was made in July 1997, but was unable to yield a precise result to the presence of an unwanted software filter left over from an earlier experiment. A third run in September 2001 was carried out with precautions, such as fast on-line diagnostic data analysis, made to ensure the integrity of the data. The final analysis of this data is nearly complete and a statistical precision of better than 10^{-3} has been achieved. Corrections of the order of $10^{-3} - 10^{-4}$ are currently being calculated and a final result is expected by the end of Summer, 2005.

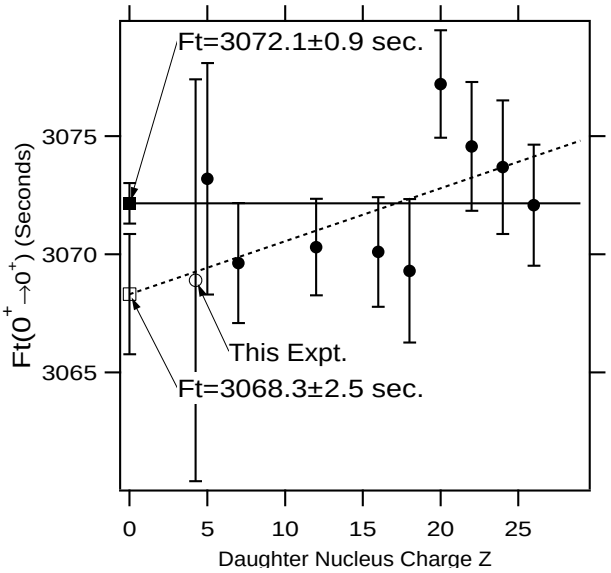

FIG. 1: The Ft-values (solid circles) of the nine precisely measured superallowed decays (^{10}C, ^{14}O, ^{26}Al^{m}, ^{34}Cl, ^{38}K^{m}, ^{42}Sc, ^{46}V, ^{50}Mn, and ^{54}Co) plotted as a function of the daughter nucleus charge Z. The solid line is the weighted average. The dashed line is the result of a linear fit and the open square is the extrapolation of this fit to zero charge. The open circle is the ^{10}C Ft-value using the superallowed branching ratio from the first GAMMASPHERE run [3].

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